

CLAIMS

1. A semiconductor device comprising:

an insulation film formed on a substrate;

a buried metal interconnect formed in the insulation film; and

5 a barrier metal film formed between the insulation film and the metal interconnect,

wherein the barrier metal film is a metal compound film, and

wherein the metal compound film contains at least one of elements forming the

insulation film.

10 2. The semiconductor device of claim 1, wherein the metal compound film is a

metal nitride film, and

wherein the insulation film contains nitrogen.

15 3. The semiconductor device of claim 1, wherein the metal compound film is a

metal oxide film, and

wherein the insulation film contains oxygen.

20 4. The semiconductor device of claim 1, wherein the metal compound film is a

metal carbide film, and

wherein the insulation film contains carbon.

25 5. The semiconductor device of claim 1, wherein the metal compound film is a

metal silicide film, and

wherein the insulation film contains silicon.

6. The semiconductor device of claim 1, wherein a metal forming the metal compound film is a refractory metal.

7. The semiconductor device of claim 1, wherein the metal interconnect is formed
5 of copper or an copper alloy.

8. A semiconductor device comprising:

an insulation film formed on a substrate;

a buried metal interconnect formed in the insulation film; and

10 a barrier metal film formed between the insulation film and the metal interconnect,
wherein the barrier metal film is formed of a metal compound film provided so as
to be in contact with the insulation film and a film including one or more metal-containing
layers and formed on the metal compound film, and
wherein the metal compound film contains at least one of elements forming the
15 insulation film.

9. The semiconductor device of claim 8, wherein the film including one or more
metal-containing layers is formed of a metal film, a metal compound film or a multi-layer
film including a combination of selected ones of the metal film and/or the metal compound
20 film.

10. The semiconductor device of claim 8, wherein the metal compound film is a
metal nitride film, and
wherein the insulation film contains nitrogen.

11. The semiconductor device of claim 8, wherein the metal compound film is a metal oxide film, and
wherein the insulation film contains oxygen.

5 12. The semiconductor device of claim 8, wherein the metal compound film is a metal carbide film, and
metal carbide film, and
wherein the insulation film contains carbon.

10 13. The semiconductor device of claim 8, wherein the metal compound film is a metal silicide film, and
metal silicide film, and
wherein the insulation film contains silicon.

14. The semiconductor device of claim 8, wherein a metal forming the metal compound film is a refractory metal.

15 15. The semiconductor device of claim 8, wherein the metal interconnect is formed of copper or a copper alloy.

20 16. A semiconductor device comprising:
an insulation film formed on a substrate;
a buried metal interconnect formed in the insulation film; and
a barrier metal film formed between the insulation film and the metal interconnect,
wherein the barrier metal film is formed of a metal compound film of a metal silicide film or a metal carbide film provided so as to be in contact with the insulation film,
25 and

wherein the insulation film contains a IV-group element.

17. The semiconductor device of claim 16, wherein a metal forming the metal compound film is a refractory metal.

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18. The semiconductor device of claim 16, wherein the metal interconnect is formed of copper or a copper alloy.

19. A semiconductor device comprising:

10 an insulation film formed on a substrate;
 a buried metal interconnect formed in the insulation film; and
 a barrier metal film formed between the insulation film and the metal interconnect,
 wherein the barrier metal film is formed of a metal compound film of a metal
 silicide film or a metal carbide film provided so as to be in contact with the insulation film
15 and a film including one or more metal-containing layers formed on the metal compound
 film, and

 wherein the insulation film contains a IV-group element.

20. The semiconductor device of claim 19, wherein the film including one or more
20 metal-containing layers is formed of a metal film, a metal compound film or a multi-layer
 film including a combination of selected ones of the metal film and/or the metal compound
 film.

21. The semiconductor device of claim 19, wherein a metal forming the metal
25 compound film is a refractory metal.

22. The semiconductor device of claim 19, wherein the metal interconnect is formed of copper or a copper alloy.

5 23. A semiconductor device comprising:
 a first insulation film formed on a substrate;
 a buried metal interconnect formed in the first insulation film;
 a barrier metal film formed between the first insulation film and the metal interconnect,

10 wherein a second insulation film is formed between the first insulation film and the barrier metal film, and
 wherein the barrier metal film is a metal compound film, and
 wherein the metal compound film contains at least one of elements forming the second insulation film.

15 24. The semiconductor device of claim 23, wherein a film including one or more metal-containing layers is further formed between the metal compound film and the metal interconnect.

20 25. The semiconductor device of claim 23, wherein the film including one or more metal-containing layers is formed of a metal film, a metal compound film or a multi-layer film including a combination of selected ones of the metal film and/or the metal compound film.

25 26. The semiconductor device of claim 23, wherein the metal compound film is a

metal nitride film, and

wherein the second insulation film contains nitrogen.

27. The semiconductor device of claim 23, wherein the metal compound film is a

5 metal oxide film, and

wherein the second insulation film contains oxygen.

28. The semiconductor device of claim 23, wherein the metal compound film is a

metal carbide film, and

10 wherein the second insulation film contains carbon.

29. The semiconductor device of claim 23, wherein the metal compound film is a

metal silicide film, and

wherein the second insulation film contains silicon.

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30. The semiconductor device of claim 23, wherein a metal forming the metal compound film is a refractory metal.

31. The semiconductor device of claim 23, wherein the metal interconnect is

20 formed of copper or a copper alloy.

32. A semiconductor device comprising:

a first insulation film formed on a substrate;

a buried metal interconnect formed in the first insulation film; and

25 a barrier metal film formed between the first insulation film and the metal interconnect,

wherein a second insulation film is formed between the first insulation film and the barrier metal film;

wherein the barrier metal film is formed of a metal compound film of a metal silicide film or a metal carbide film, and

5 wherein the second insulation film contains a IV-group element.

33. The semiconductor device of claim 32, wherein a film including one or more metal-containing layers is further formed between the metal compound film and the metal interconnect.

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34. The semiconductor device of claim 32, wherein a metal forming the metal compound film is a refractory metal.

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35. The semiconductor device of claim 32, wherein the metal interconnect is formed of copper or a copper alloy.

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36. A method for forming a semiconductor device, comprising the steps of:
forming a recess portion in an insulation film formed on a substrate;
forming a barrier metal film of a metal compound film containing at least one of
elements forming the insulation film so that the barrier metal film covers at least surfaces
of the recess portion; and

forming a buried metal interconnect on the barrier metal film so that the buried
metal interconnect fills the recess portion.

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37. The method of claim 36, further comprising the steps of:

forming a recess portion in a first insulation film formed on a substrate;

forming a second insulation film so that the second insulation film covers at least surfaces of the recess portion;

forming, on the second insulation film, a metal compound film containing at least one of elements forming the second insulation film; and

5 forming a buried metal interconnect on the metal compound film so that the buried metal interconnect fills the recess portion.

38. The method of claim 36, wherein the step of forming a barrier metal film includes the step of further forming, after formation of the metal compound film, a film 10 including one or more metal-containing layers on the metal compound film to obtain the barrier metal film including the metal compound film and the film including one or more layer of one or more metals.

39. The method of claim 38, wherein the film including one or more metal-containing layers is a metal film, a metal compound film or a multi-layer film including a 15 combination of selected ones of the metal film and/or the metal compound film.

40. The method of claim 36, wherein the metal oxide film is a metal nitride film, and

20 wherein the insulation film formed so as to be adjacent to the metal compound film contains nitrogen.

41. The method of claim 36, wherein the metal compound film is a metal oxide film, and

25 wherein the insulation film formed so as to be adjacent to the metal compound film contains oxygen.

42. The method of claim 36, wherein the metal compound film is a metal carbide film, and

wherein the insulation film formed so as to be adjacent to the metal compound film
5 contains carbon.

43. The method of claim 36, wherein the metal compound film is a metal silicide film, and

wherein the insulation film formed so as to be adjacent to the metal compound film
10 contains silicon.

44. The method of claim 36, wherein a metal forming the metal compound film is a refractory metal.

15 45. The method of claim 36, wherein the metal interconnect is formed of copper or a copper alloy.

46. A method for fabricating a semiconductor device, comprising the steps of:
forming a recess portion in an insulation film formed on a substrate and containing
20 a IV-group element;

forming a barrier metal film including a metal compound film of a metal silicide film or a metal carbide film so that the barrier metal film covers at least surfaces of the recess portion; and

25 forming a buried metal interconnect on the barrier metal film so that the buried metal interconnect fills the recess portion.

47. The method of claim 46, wherein the step of forming a barrier metal film includes the step of forming, after formation of the metal compound film, a film including one or more metal-containing layers on the metal compound film to obtain the barrier metal film including the metal compound film and the film including one or more metal-containing layers.

48. The method of claim 46, wherein a metal forming the metal compound film is a refractory metal.

10 49. The method of claim 46, wherein the metal interconnect is formed of copper or a copper alloy.

50. A method for fabricating a semiconductor device, comprising the steps of:
forming a recess portion in a first insulation film formed on a substrate;
15 forming a second insulation film including a IV-group element so that the second insulation film covers at least surfaces of the recess portion;
forming, on the second insulation film, a barrier metal film including a metal compound film of a metal silicide film or a metal carbide film; and
forming a buried metal interconnect on the barrier metal film so that the metal
20 interconnect fills the recess portion.

51. The method of claim 50, wherein the step of forming the barrier metal film includes the step of forming, after formation of the metal compound film, a film including one or more metal-containing layers on the metal compound film to obtain the barrier metal film including the metal compound film and the film including one or more metal-

containing layers.

52. The method of claim 50, wherein a metal forming the metal compound film is a refractory metal.

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53. The method of claim 50, wherein the metal interconnect is formed of copper or a copper alloy.